

Low-Code Platforms: Supporting Business Process Innovation for SMEs

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Low-code platforms (LCPs) enable the rapid creation and deployment of business applications with minimal coding, providing a valuable shortcut for stakeholders, especially in small and medium-sized enterprises (SMEs). This facilitates the quick and cost-effective development of various services and products, which is crucial in today's fast-paced business environment. To better understand the potential benefits and drawbacks of LCPs for process innovation and efficiency in SMEs, this paper conducts a literature review of the relationship between LCPs and the key business characteristics of the SME environment. The study also conducts a survey of companies and interviews with experts. In this way, the research compares the benefits and challenges identified in the literature with those recognised in practice, filling the gap left by previous research through the unique combination of interviews, surveys, and a literature review. The results of the research show that LCPs facilitate business process innovation and adaptability in today's rapidly evolving environment and support business process innovation for small-medium enterprises (SMEs)

Additional Key Words and Phrases: Low-code platforms (LCPs), Small and medium-sized enterprises, Business Process Innovation, Efficiency, Rapidly evolving business environment, Strategic benefits

1 INTRODUCTION

In today's business environment, agility is no longer optional for organisations (Harraf et al., 2015). As Yusuf et al. (2022) mention, in the current digitalisation era, small and medium-sized enterprises (SMEs) must make decisions quickly, facilitate communication, and respond rapidly to changes. All of this is important because it is the most crucial factor for an organisation to survive in the dynamic business world and to be able to be competitive in any local or global market (Yusuf et al., 2022). Therefore, organisations must use techniques to develop their applications quickly and affordably. Additionally, minimising the effort required for setup and configuration is crucial, given the high cost of employing skilled workers.

Thus, low-code platforms (LCPs) serve as suitable solutions to meet the needs of SMEs due to their high agility (Phalake et al. 2021). By reducing maintenance and offering ready-to-use components, LCPs accelerate the development cycle for new products or services compared to traditional application development (Krishnaraj et al., 2022; Aveiro et al., 2023). Additionally, they are well-known for their user-friendly visual environments, accessible to developers and non-developers, and they reduce effort across various software development phases (Sagat et al., 2020; Wazkowski, 2019). This makes them particularly useful for addressing the challenges SMEs face.

LCPs, also known as low-code development platforms (LCDPs), are commonly available as cloud-based Platform-as-a-Service (PaaS) software (Massimo et al., 2019). This approach not only speeds up deployment and simplifies maintenance but also requires smaller investments from enterprises (Massimo et al., 2019; Ostroukh et al., 2022; Krishnaraj et al., 2022; Phalake et al., 2021). Their straightforward setup significantly shortens a startup phase compared to traditional development platforms, enabling a rapid kick-off (Aveiro et al., 2023; Phalake et al., 2021). Additionally, the platform configuration process requires fewer steps due to pre-built modules and drag-and-drop interfaces, minimising or eliminating handwritten code and enhancing efficiency (Phalake et al. 2021). In this paper, efficiency will be measured in resource allocation, time and cost-savings. According to Aveiro et al. (2023) the low-code approach reduces the required effort by 94.63% compared to traditional methods. Moreover, the consistency across different LCPs within an enterprise and the platforms' inherent user-friendliness simplify and improve staff training, allowing easier adoption and use inside a company in comparison with a traditional development project (Ostroukh et al., 2022; Krishnaraj et al., 2022, Phalake et al. 2021). This is why LCPs are popular solutions for many enterprises and often align well with the needs of SMEs. However, despite these benefits, some notable drawbacks are associated with LCPs. One significant challenge developers face when working with LCPs is the inability to access and directly modify the source code, which sometimes limits their ability to fulfil specific requirements (Juhás et al., 2022). Additionally, interoperability issues among different LCPs and scalability challenges are concerns highlighted in the literature when discussing the limitations of LCPs (Vincent et al., 2019; Sahandi et al., 2016; Ji, 2024).

Globally, LCPs have an established history and have been widely adopted over the past decade. In 2018, OutSystems concluded that such platforms are used by 41% of participating companies (OutSystems, 2018). Additionally, according to Phalake et al. (2021), a February 2017 Salesforce report revealed that 82% of IT leaders interviewed in the U.S. believe their organisations are prepared to start developing their applications using low-code solutions (Phalake et al. 2021). Vincent et al. (2019), working for Gartner - leading technology research firm, even predicts that by 2024, three-quarters of all large enterprises will use at least four low-code development tools, underscoring their significant role

in the enterprise sector. Moreover, Vincent et al. (2019) also predict that 65% of all application development will be conducted through LCP, highlighting their growing importance in the software development landscape.

Given the rapidly increasing interest in LCPs and the significant number of software applications already developed using such platforms, this paper aims to achieve the following objectives. Firstly, to collect systematic insights into the potential benefits and challenges that LCPs offer regarding process innovation and efficiency for small and medium-sized enterprises. By efficiency we mean...save time/money This goal is pursued through a literature review examining the relationship between LCPs and the SME environment for innovation, highlighting the key differences from typical development cycles. Secondly, this research uses the true experimental study design method. This allows the research to move further from plain theory and gain more practical information using surveys and interviews. The primary issue this paper addresses is the need for more awareness among SME owners and employees regarding the substantial opportunities for rapid development and the hidden advantages of using an LCP solution over a traditionally developed one. A key research focus is to understand better why these platforms enable quicker adaptation and innovation in business processes compared to traditional software development methods and to establish a clear comparison between them. Ultimately, our contribution will be to provide a clear overview of the benefits and challenges that SMEs experience while using LCPs, as highlighted in the literature, and to compare these with insights drawn from practical applications.

2 PROBLEM STATEMENT

While extensive research exists on low-code platforms (LCPs) and their impact on business process innovation, a significant study gap still needs to be addressed. A combination of expert opinions, a targeted survey to directly capture business insights, and a literature review still need to be included. This gap mainly affects small and medium-sized enterprises (SMEs) due to their desperate need for agile solutions like LCPs. Thus, this paper addresses this issue by comprehensively analysing the benefits and challenges LCPs bring to SMEs, both discovered in theory and practice. By understanding how LCPs can facilitate business process innovation and efficiency, this paper demonstrates why they are crucial tools in today's dynamic business environment.

Considering this problem statement, the research question is as follows:

How do low-code platforms facilitate business process innovation and efficiency in today's rapidly evolving environment over traditional coding methods?

¹Search engines such as Scopus, Google Scholar, IEEE Xplore, and FindUT were utilized to identify relevant papers.

This research question can be taken apart into two distinct sub-questions that help answer the question:

1. How do low-code platforms influence the speed of adaptation and innovation in business processes in today's dynamic market conditions?
2. How do low-code platforms affect operational efficiency and competitiveness in organizations in the digital era?

3 RELATED WORKS

Relevant papers were identified using various search engines ¹. The search terms included "Low-code platforms (LCPs)", "Small and medium-sized enterprises", "Low-code platforms benefits", "Business Process Innovation", "Traditional vs low-code development" and "Drawbacks of low-code platforms". Using those terms, many documents were retrieved, and the most relevant based on their overall findings were selected. In a later stage of the research, a literature review (LR) is performed to better structure the results.

Considerable research has been conducted on low-code platforms (LCPs), highlighting their advantages such as rapid application development, user-friendly interfaces accessible to both developers and non-developers and their substantial potential (Ostroukh et al., 2022; Sagat et al., 2020; Wazkowski, 2019, Krishnaraj et al., 2022, Phalake et al. 2021). Further studies specifically address the significance of LCPs for small and medium-sized enterprises (SMEs), underscoring their crucial role in quickly developing new business applications in comparison to traditional software development (Elshan et al., 2023; Bies et al., 2022; Aveiro et al., 2023). In parallel, the potential drawbacks — such as scalability challenges, interoperability issues, and the inability to access and directly modify the source code — are also acknowledged, providing a complete picture of LCPs (Vincent et al., 2019; Juhas et al., 2022, Sahandi et al., 2016, Ji, 2024). Insights from these studies help design targeted questions for expert interviews and guide the survey to analyse the practical impact of LCPs on business operations. Acknowledging that the current literature does not provide a comprehensive analysis that integrates a literature review with an interview and survey to investigate the practical impacts of LCPs on business operations, conducting this type of research helps bridge the gap between existing academic research and the real-world use of LCPs.

4 LITERATURE REVIEW

The first step of this research would be to carefully consider the available literature, aiming to recognise the benefits and drawbacks of low-code platforms (LCPs), as well as the key business characteristics of medium-sized enterprises (SMEs) and their role in the economies of developing countries.

4.1 Benefits of low-code platforms

LCPs were established in Information Technology in 2011 when they were first recognised as novel and cutting-edge programming solutions, as Waszkowski (2019) indicated. Since then, numerous studies have been conducted to explore the benefits of these platforms, and many have cited Waszkowski's paper, such as Sahay et al. (2020) and Elshan et al. (2023).

A primary benefit identified by several sources, including Totterdale (2018), is the significantly accelerated project development process that LCPs offer compared to traditional software development methods. For instance, a case study by Totterdale (2018) reported potential results from a three-week development process using a low-code platform (LCP). Additionally, Totterdale (2018) mentioned that this task could not be achieved even after several months of using traditional software methods. Further, Waszkowski (2019) and Ostroukh (2022) note that the reduced time associated with the LCPs development process stems from the minimal manual coding required. This advantage is primarily attributed to the empowerment of employees, as Elshan et al. (2023) note, allowing staff from various departments to participate actively in the app development process. This empowerment fosters a collaborative culture between business units and IT departments, enhancing cross-functional decision-making (Krishnaraj et al., 2022).

Another significant benefit is the flexibility that LCPs bring to companies. Research by Elshan et al. (2023) using interviews with practitioners from the field indicates that LCPs are well known for their easy adaptability with minimal effort. This adaptability extends to even reusing artefacts from previous projects, which, as Phalake et al. (2021) suggest, enables businesses to adjust to changes and release new versions swiftly, thus aligning LCPs abilities closely with dynamic business and client needs.

A third significant benefit is the reduced complexity that LCPs offer compared to traditional technologies for software development. According to Waszkowski (2019), later supported by Sahay et al. (2020) and Elshan et al. (2023), LCPs enable even non-technical users - also known in those sources as citizen developers - to engage in creating and modifying applications. As Phalake et al. (2021) discuss, this inclusion is facilitated by visual modelling tools that simplify process design. Also known as drag-and-drop interfaces, those tools, according to Phalake et al. (2021), allow these citizen developers to rapidly develop applications, making the transition of ideas into business applications easily possible.

Moreover, numerous other distinct benefits of LCPs are recognised in the literature. For instance, Krishnaraj et al. (2022) highlight the ongoing development and release of new updated versions of the existing LCPs, suggesting improvements for potential vulnerabilities and technical problems. As Elshan et al. (2023) point out, these platforms' interoperability is enhanced through APIs (Application Programming Interfaces) that connect with other applications, providing valuable integration

opportunities for businesses. Furthermore, Tisi et al. (2019) mention that LCPs are often offered as cloud-based Platform-as-a-Service (PaaS) software, which ensures robust security through layered defence strategies and encryption, as detailed later by Krishnaraj et al. (2022).

4.2 Drawbacks of low-code platforms

After reviewing the benefits of LCPs, it is equally important to examine the identified drawbacks. This paper aims to discuss these recognised drawbacks of LCPs, challenging the previously mentioned benefits to draw a conclusion later in section 7 if the recognised benefits are not actual drawbacks.

A notable drawback is the visual builder of LCPs, mentioned as a benefit by Phalake et al. (2021) yet identified as a limitation by Krishnaraj et al. (2022), Sahay et al. (2020), and Juhas et al. (2022). Krishnaraj et al. (2022) criticise these builders for offering limited customisation options, while Sahay et al. (2020) and Juhas et al. (2022) argue that the graphical interfaces could be more intuitive than claimed. An important observation from Wiener et al. (2018) is that these limitations are universally recognised across various LCPs.

Interoperability is another significant drawback highlighted in the literature for the majority of LCPs. Krishnaraj et al. (2022) point out that LCPs often struggle to integrate with older legacy systems, complicating transitions for some businesses. Additionally, Sahay et al. (2020) identify a need for industry standards as a problem which blocks different applications' ability to exchange information effectively. Another significant concern often associated with LCPs is "vendor lock-in," highlighted as a major drawback in the literature by Bies et al. (2022). Once an application developed using an LCP expands, migrating it to a different platform becomes challenging, resulting in a strong dependency on the original provider (Bies et al., 2022). Sahay et al. (2020) also mention another critical drawback: the limited capability of LCPs to incorporate new functionalities, which in some cases is entirely impossible, making it unfeasible for the business to seek application capability extension.

4.3 SMEs key business characteristics, needs, and competitive advantages

Another topic of the literature in which this research is embedded is SMEs. The objective is to identify SMEs' essential key business characteristics, needs, and competitive advantages to assess whether LCPs can support SMEs and influence their speed of adaptation and innovation.

Firstly, it is necessary to define what constitutes an SME. According to Elshan et al. (2023), referencing the European Union definition, an SME is characterised primarily by its number of employees, typically fewer than 250. Furthermore, according to Elshan et al. (2023), citing the European Union definition, an SME should have an annual turnover of less than

50 million EUR and an annual balance sheet total of less than 43 million EUR (European Union, 2003).

Understanding the classification of SMEs sets the stage for exploring their distinctive key business characteristics and advantages. Notable research by Jacke (2009) highlights the responsiveness to technological and market changes and efficient internal communications within SMEs as key advantages over more giant corporations. These attributes are crucial as they enhance operational efficiency and overall performance, as Jacke (2009) concluded. Gallego-Roquelaure (2019) confirm those conclusions, emphasising the importance of agility for SMEs. Additionally, Martínez et al. (2021) delve into the critical role of internal communication in fostering operational efficiency, confirming the recognition in the much earlier work of Jacke (2009).

The influence of the business owner is another pivotal factor in the dynamics of SMEs, as Jacke (2009) concluded. The owner's entrepreneurial spirit and innovation drive are generally beneficial, as noted by Jacke (2009). This aspect is further explored in the study by Thornsri (2023), which discusses leadership characteristics across various stages of SME development. Thornsri (2023) discusses the vital role of leadership in business growth, concentrating on the crucial figure of the leader. However, the research by Jacke (2009) critically mentioned that this dependency could pose risks, as the business's survival may become overly centralised around one individual.

Lastly, in this research, the broader economic role of SMEs is explored. According to Gallego-Roquelaure (2019), SMEs significantly contribute to private-sector employment and economic growth, serving as the backbone of many countries' economies. This view is also stated by earlier findings from Tambunan (2008), who noted in 2008 that SMEs are crucial for economic development due to their role as significant employment providers. Also, SMEs are positioned as critical players in sustaining existing industries and fostering the growth of new sectors (Gallego-Roquelaure, 2019).

4.4 SMEs' role in developing countries

As highlighted in Section 4.3, SMEs are pivotal for employment and economic growth. To understand the scope of this research, which includes conducting a survey in Bulgaria—a developing country in Eastern Europe—it is necessary to review relevant literature and studies focused on Bulgaria.

Danchev (2021) verified that SMEs play a crucial role in Bulgaria, indicating that the stability of the country's economy heavily relies on the dynamic development of its SMEs. Further exploration into Bulgarian SMEs is provided by a government study from The Executive Agency for the Promotion of Small and

Medium-sized Enterprises (IANMSP). Their research revealed a strong willingness among Bulgarian SMEs to invest in innovation to enhance competitiveness and sustainable growth. However, financial constraints are significant, and 74% of the respondents stated they could only fund 10% to 30% of the necessary investments for innovation (IANMSP, 2016).

5 INTERVIEWS

After a clear overview of the benefits and drawbacks of low-code platforms (LCPs) and knowing their role in small-medium enterprises (SMEs), the research performed two interviews. Both interviews were conducted using a semi-structured methodology, guided by the questions in Appendix B, allowing interviewees ample opportunity to express their ideas (Longhurst, 2003). One of them was with a Business and IT alumnus from the University of Twente who works as a consultant for a company specialising in Mendix solutions². The other interview was with a person who had dedicated more than ten years to academia. The interviews play a crucial role in this paper, helping to validate the theoretical findings and raise important new questions.

5.1 Interview with a business expert

The first interview was conducted with a business and IT alumnus, who brought a unique perspective to the discussion. He currently works as a consultant for a company specialising in Mendix solutions. Despite initial struggles with programming during his studies, he found that viewing projects as models rather than just lines of code significantly improved his development skills. His extensive experience includes roles as a consultant, educator, and researcher, focusing primarily on modelling business processes and solutions for a diverse range of clients and projects, including many SMEs.

During the interview, he discussed several benefits of LCPs that align with the literature. For instance, he appreciates how LCPs enable rapid teaching and application development at the University of Twente. He noted that students could develop applications in 4 weeks—a task that would be impractical with traditional programming in a much bigger timeframe. He also highlighted the accessibility of LCPs, which allows a broader range of individuals to engage with technology, contrary to the more restrictive nature of traditional programming.

A key advantage of LCPs he discussed is their cost-effectiveness for the clients - SMEs. Initially, clients might find low-code platform-based solutions expensive. However, they recognize the long-term cost benefits due to the integrated aspects, such as security and operational environments, that do not require extensive setup. He also pointed out the rapid release cycles of LCPs, which continually introduce enhanced features, ensuring improved security, management, and development processes.

² Mendix is a low-code development platform where users can access all features through drag-and-drop builders, eliminating the need for code writing. It supports real-time collaboration with peers and

includes a visual development tool that facilitates the reuse of various components (Sahay et al., 2020).

The interviewee also pointed out that the agility LCPs provide is particularly beneficial for SMEs. He shared a compelling example involving a client from the insurance industry who utilized a low-code platform to respond to new regulations rapidly. The client needed to adjust their system within two months to comply with a new governmental law, a challenge faced by all companies in the sector. Unlike their competitors, who struggled, this client was the only one able to implement the necessary changes on time, leveraging the flexibility of the low-code platform.

The expert also elaborated on LCPs' limitations, emphasizing the need for proficient developers to manage and streamline the development process effectively. He noted that LCPs' interoperability has improved due to new tools on the market that offer greater flexibility, allowing for easier integration with other systems. However, the success of LCP implementations or transitions crucially depends on thorough initial discussions to define clear project objectives and structure based on the expertise of skilled developers.

He also addressed the common criticisms regarding LCPs, such as limited customization options and non-intuitive interfaces. He argued that these issues could be substantially mitigated through careful project planning and active client engagement to clarify their needs and expectations. Manual coding may become necessary to fulfil specific customization demands when the platform's built-in options are insufficient. This approach underscores the importance of having developers with a robust skill set to extend the platform's capabilities beyond its standard offerings if you want to overtake some of the LCP's limitations.

He concluded the interview on a positive note and was optimistic about the future of LCPs. He suggested a scenario where business owners could generate applications from a Business Model Canvas with the push of a button. However, he acknowledged that automated systems are still capable of handling many assumptions. This vision illustrates the evolving ease and potential of LCPs to transform business operations dramatically.

5.2 Interview with an academia person

The second participant in the interview has dedicated more than ten years to academia, working for a while back in 2011 on a PhD in a field equivalent to current LCPs studies. Currently employed at the University of Twente, she has a deep passion for LCPs and academic research. She predicts a growing demand for LCPs and applications, citing Gartner (2023). Therefore, foreseeing a shift, the IT talents and other employees will become knowledgeable employees empowered to create tools and solutions for their own needs, thus also needing to learn to use low-code as concluded by the participant.

During the discussion, she highlighted the potential of LCPs to bridge the gap between developers and business stakeholders, explicitly mentioning that this will avoid costly modifications later due to the end user's participation in the development

process. Unlike high-code (HC) solutions, where communication barriers often exist in the process of requirements engineering, LCPs simplify interactions, allowing business clients to engage more directly in development processes. An example discussed during the interview was that HC typically requires extensive initial documentation. At the same time, the process in the low-code (LC) world is different. LC allows immediate requirement gathering via prototype development and testing that accelerates the development process, and enhances efficiency through direct customer involvement, thus also avoiding time- and cost-consuming modifications due to miscommunicated requirements.

An insight from the interview was her perspective on the learning curve associated with LCPs. Regardless of programming knowledge, individuals can learn to use LCPs relatively quickly. However, those with HC experience tend to achieve higher-quality outcomes as they can deliver complete lifecycle applications that meet the quality requirements thanks to technical knowledge enabling assessing various risks related to output applications. This is particularly crucial for SMEs and start-ups, which often have difficulties finding and hiring IT talents and thus rely on business-oriented citizen developers and may unintentionally introduce issues during the application development process, e.g. security risks.

She also shared her concerns about the drawbacks of LCPs. One major issue mentioned was the limited scientific literature because the domain is relatively new, indicating a need for further research. Another problem discussed was the simplicity of developing applications through LCPs, which could lead to security vulnerabilities due to the citizen developers' lack of technical knowledge. Moreover, citizen developers' ease of access to development with LC might result in a market flooded with duplicate solutions, diminishing innovations and bringing a significant negative environmental impact that will eventually lead to sustainable development issues, e.g., ineffective resource consumption.

In her role at the University of Twente, she contributed to the Master's course in Business Information Technology (BIT) by designing and piloting a course called Low Code Application Development. This course aims to teach students about the philosophy of low-code/no-code development technologies, addressing topics like value for business, advantages and disadvantages, AI-driven low-coding, the cultural adaptations needed for LC adoption and digital transformation through LC and comparative overview of LC and HC development lifecycle. The course objectives are to describe the different types of LC approaches and platforms and equip the students with the knowledge to distinguish where HC and LC solutions are advisable to be used and the integration perspectives. It encourages self-directed learning and discussions on critical issues like security, use experiences, critically reflecting on commonalities and distinctions of various platforms such as Mendix, Thinkwise, and Outsystems and being able to recommend a platform choice for a given business case. This

course shows the forward-thinking and entrepreneurial approach of the University of Twente, illustrating how the inclusion of LCPs in business education prepares future business and IT professionals to fully leverage the opportunities that LCPs present in the business world.

Regarding the future of LCPs, she anticipates a shift from model-based to text-based development, where an AI system will convert textual descriptions directly into functional software. However, she stressed the irreplaceable role of human oversight in ensuring personalized and contextually appropriate solutions, with AI automating repetitive tasks. She envisions a gradual transition toward using LC solutions, extending beyond software to various aspects of technological interaction. In the long run, she also mentioned quantum LC possibilities.

6 SURVEYS

In the final phase of the research, a survey was conducted with small-medium enterprises (SMEs) in Bulgaria, with different turnovers coming from various industries. The survey stands out from those observed in the literature review due to its unique focus on SMEs in a developing country and its use of closed-ended and Likert scale questions for data collection. In Bulgaria, SMEs employ over 75% of the workforce and generate 65% of the value added (PricewaterhouseCoopers, 2019). The survey aimed to examine SMEs' key business characteristics and identify whether they have implemented low-code platforms (LCPs) solutions. Those who had already adopted LCPs (approximately 40% of all participants) were asked to elaborate on the benefits and drawbacks they experienced, and referred as adopters later, while the other 60% provided insights into their perceived benefits and drawbacks of such platforms, mentioned as non-adopters.

6.1 General information

The survey garnered responses from 24 SME representatives, with the majority not occupying technical positions. The industry distribution of the participating SMEs was diverse: 10 were from the service sector, six were from information technology, and the remainder spread across tourism, manufacturing, and others. All the respondents confirmed they had websites, half confirmed that they were developed through traditional software.

6.2 LCP Benefits

In this section, participants' responses were categorised into two groups: the first who have realised actual benefits from using LCPs, the adopters, and the second who perceive potential benefits, the non-adopters.

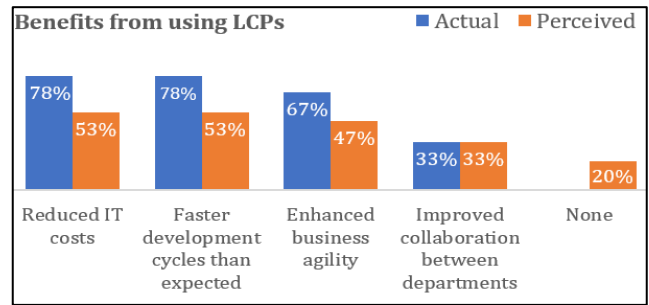


Figure 1: Results of the benefits of using LCPs

The survey initially investigated the benefits of using LCPs for software development compared to traditional coding methods, providing an opportunity for the participants to select multiple answers (Figure 1). Both groups acknowledged significant cost reductions, a faster development cycle, and enhanced business agility as critical advantages of LCPs, mentioning them together. Notably, all of the adopters reported a lack of benefits, whereas 20% of the non-adopters were sceptical about their advantages.

Further, using a different set of questions about the benefits identified by the literature review revealed that 80% of respondents using LCPs experienced quicker software development than when traditional coding methods were used. Additionally, nearly 90% reported substantial cost reductions. Therefore, a critical finding about LCP adoption is that those platforms enable companies to respond swiftly to market changes. Moreover, 85% of the adopters recognise improved collaboration within their organisations and better scalability of operations as a result of LCP adoption. In contrast, based on the responses to those questions, the non-adopters exhibited more scepticism, with many expecting no significant improvements and generally providing neutral responses.

6.2 LCP drawbacks

The survey also examined the drawbacks of LCPs, grouping responses similarly as in the benefits section.

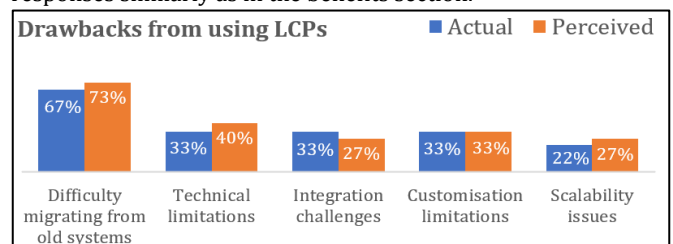


Figure 2: Results about the drawbacks of using LCPs

Both groups evaluated the drawbacks identified by the literature review, as illustrated in Figure 2. When participants assessed specific drawbacks through targeted questions, the results generally fell within the moderate range, showing that they were not a significant threat to them. Most of the adopters noted moderate challenges with integrating these solutions into existing systems and expressed some security concerns. By additional questions, the survey found that 80% of these

participants reported minimal or moderate difficulties in user adoption and only moderate concerns regarding innovation restrictions and vendor dependency. On the contrary, the participants without LCP integration perceived these challenges as more significant, expressing moderate to deep concerns across all the listed drawbacks, demonstrating a more sceptical view towards adopting LCPs.

6.3 SMEs' key business characteristics

The survey examines whether the key characteristics of SME businesses identified in the literature review align with those observed in practice. Over 80% of participants recognised adaptability and the potential to customise solutions as crucial for their SME operations. Similar importance was given to innovating, keeping up with market demands, and being prompt and responsive to customer feedback, underscoring the necessity of flexibility and adaptability in dynamic business environments.

Regarding leadership, over 65% of respondents underlined the leadership style of the top management as a significant influence on innovations and a mix of shared and centralised decision-making. However, 20% of the participants recognize their company as a highly centralised decision-making process, highlighting the considerable impact of solo leadership decisions on the SME's operations. Notably, 95% of respondents rated their internal communication moderate to very effective for optimizing their procedures. This group also indicated that increased financial resources would directly encourage further investment in new applications, illustrating the strong link between financial resource availability and innovations within SMEs in Bulgaria.

7 Discussion

Following the analysis of low-code platforms (LCPs) and small-medium enterprises (SMEs) by the literature review, it is crucial to assess the findings across the discussed topics: the benefits and drawbacks of LCPs, the key business characteristics, needs, and market advantages of SMEs, and the role SMEs play in developing countries. This discussion allows us to draw meaningful conclusions, understand the implications of integrating LCPs within SME operations, and confirm them with the interviews and survey results. On the one hand, the varied insights from the expert interviews confirm the benefits noted in Section 4.1, including cost savings, and discuss some drawbacks listed in Section 4.2 while also highlighting new concerns, such as sustainability and market oversaturation with similar solutions. On the other hand, the survey results reveal essential trends. Participants affirmed the critical business characteristics of the SMEs identified in the literature. They shared their views on the recognised benefits and drawbacks of LCPs. Specifically, SME representatives who have implemented LCPs exhibit greater confidence in the benefits and are less sceptical about the drawbacks. Together, the insights from the interviews and the survey results validate the theoretical findings discussed in

Section 4, achieving the primary goal of the practical component of this research.

While the benefits of LCPs are extensively researched in Section 4.1, Section 4.2 presents several drawbacks that could undermine these advantages. By using the survey results and according to the literature, the paper proves that interoperability challenges, limited customisation options, and constraints on new functionalities are recognized drawbacks of LCPs. However, a critical observation from the first interview addresses that with expert intervention, these challenges are not actual drawbacks but rather perceived obstacles. Also, based on a thorough analysis of the survey results, it is notable that respondents who need LCP integration are more sceptical about potential benefits such as enhanced collaboration, agility, and scalability in their responses in compare to those who already integrated LCPs. Additionally, those yet to adopt LCPs express more significant concerns about possible drawbacks in general. This comprehensive analysis underscores the value of expert guidance in navigating perceived drawbacks. It highlights the perceptions among SMEs regarding the adoption and impact of LCPs.

As identified in Section 4.3, agility and the need to respond to market changes are crucial for SMEs. LCPs match those needs based on the findings in Section 4.1 due to their ability to be easily adaptable with minimal effort and to allow reusing artefacts from previous projects. Also, the accelerated project development process that LCPs offer, as concluded in Section 4.1, can benefit any product testing for SMEs, minimising the needed resources for obtaining results and fostering innovation. Another match between the benefits of LCPs found in Section 4.1 and the operational dynamics of SMEs is the empowerment of non-technical staff. It allows them to actively participate in developing new software applications, fostering a collaborative culture and enhancing decision-making processes. This empowerment and effective internal communication within SMEs create an ideal environment for boosting operational efficiency and improving the pace of adaptation and innovation in business processes, aspects crucial for SMEs, as observed in Section 4.3. Also, the empowerment inclusivity extends to the leaders within SMEs, who often play pivotal roles and, with LCPs, can engage directly in software development activities without needing extensive technical knowledge. All of this is confirmed in the interviews, where both participants confirm the excellent match between LCPs and SMEs, which the survey results can also conclude.

Lastly, LCPs can lead to significant economic advantages for SMEs in developing countries, such as cost reductions, enhanced productivity, and quicker market entry for new products or services based on the survey results and interviewees' opinions. Specifically, the survey results from Section 6 demonstrate how LCPs notably enhance operational efficiency and competitiveness among SMEs. These benefits are especially relevant given the challenges SMEs face in developing countries like Bulgaria, where there is a need to minimise investment

while maximising innovation and economic returns, as the results of Section 4.4 show.

8 Conclusions

As a conclusion of this research, low-code platforms (LCPs) facilitate business process innovation and adaptability in today's rapidly evolving environment and support business process innovation for small-medium enterprises (SMEs). This was proven by the research's theory and practical components. Both verified that LCPs match SMEs' needs and are better suited to traditional coding methods. An essential finding of the survey component of this research is that SME representatives who have already adopted LCPs show higher confidence in the benefits and a less sceptical view of the drawbacks of LCPs, aligning with the one recognised in the literature. Additionally, the general survey results confirmed that SMEs in Bulgaria acknowledge the benefits and drawbacks of LCPs and possess the main business characteristics identified by the literature review. Also, as confirmed by the interviews, LCPs influence the speed of adaptation and innovation in business processes in today's dynamic market conditions due to their ability to be easily adaptable with minimal effort and to allow reusing artefacts from previous projects.

However, the study also recognises several limitations.

1. The diverse backgrounds of interview participants challenge the generalisation of findings.
2. As discussed in the second interview specifically, future researches should explore the sustainability of LCP development and address potential market oversaturation, expanding the scope of LCP studies to ensure continued relevance and applicability in various business contexts.
3. Given the dynamic nature of technology and market demands, future research should focus on developing clear guidelines for SMEs considering the adoption of LCPs. These guidelines should address when and how SMEs should implement these platforms to maximise their benefits and minimise the risks. A good approach would involve a longitudinal study to examine the long-term effects of LCP adoption on SME competitiveness and growth, providing a comprehensive view of the sustained impacts and potential shifts in business strategy enabled by LCPs. A potential agenda for this study is conducting a systematic literature review to understand current guidelines, followed by an experiment testing different methodologies in a real environment and highlighting the findings.

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A Interviews outline

"During the preparation of this work the author use Grammarly PRO in order to proof-reading the final version. After using this tool/service, the author reviewed and edited the content as needed and take full responsibility for the content of the work."

B Interviews outline

The semi-structured interviews use the following questions for outline during the interviews:

B.1 General questions

Can you introduce yourself?

Can you discuss the benefits LCP solutions provide compared to traditional software development?

Can you discuss the drawbacks?

Can you compare LCP solutions and traditional coding in terms of time to market and overall development costs?

What future developments in the LCP world do you expect SMEs to be excited about?

B.2 Rapid Development and Business Agility

Can you describe how LCPs affect the software development process for SMEs compared to traditional coding methods?

Do you think LCPs are more accessible for students and easier to understand compared to traditional coding methods?

B.3 Drawbacks of LCPs

Given the criticism about limited customization options and non-intuitive interfaces in some LCPs, do you think those drawbacks exists or not?

What do you think about how LCPs can be synchronized/integrated with a legacy system?

What strategies or best practices do you recommend for SMEs to ensure smooth integration with existing IT infrastructure from your experience?